Calculation and Experimental Studies on the Formation and Emission Processes of Boron Hydride Molecules

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Toward real-time wall conditioning, impurity powder dropping experiments with boron powder were performed in the 22nd experimental campaign of the Large Helical Device. To examine the deposition and desorption process of boron, we focus on boron hydride (BH) molecules which presumably populate near plasma-facing components. We performed spatially-resolved spectroscopic measurements of emission by boron ions and BH molecules. From the measurement, we found that BH and B+ were concentrated on the divertor viewing chord, which suggest boron deposition in the divertor region. Although emissions from BH and B+ increased linearly, emissions by B0 and B4+ became constant after the middle of the discharge. Continuous reduction of carbon density in the core plasma was confirmed even after B0 and B4+ became constant. The results may show facilitation of impurity gettering by boron in the divertor region and thus effective real-time wall conditioning.

Aiming at the quantitative diagnostics of boron monohydryde, BH, in fusion plasmas, we present elastic, electronic excitation, and ionization cross sections of BH for the first time. The calculations were performed by the R-matrix and Binary Encounter Bethe methods utilized by Quantemol-EC software. To examine the uncertainty due to the calculation conditions, we compared the results by different basis sets and internuclear distances of the target model. We found that the uncertainties are typically within ~10%. Rate coefficients were derived and fitted to an Arrhenius function. The derived decay rate per photon, S/XB, agreed with the value presented by Lieder et al. (1994).